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FIELD LIFE OF ORTHENE®, SEVIN®-4-OIL AND DYLOX® 1.5 BIOASSAY WITH DOUGLAS-FIR TUSSOCK MOTH LARVAE[1]

by

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Insecticides, Sevin®-4-oil, Dylox®-1.5 and Orthene® 75S were evaluated to determine their field life against the Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough). Tests were conducted by treating 15-acre field plots by helicopter and collecting foliage samples for bioassay in the laboratory with 3d-instar larvae.

Sevin-4-oil showed little loss of residual activity for 14 days after application. Dylox-1.5 residues killed less than half the test insects after 3 days although some residual activity could be found after 14 days. The short field life of Dylox may have been partly because of rainfall, which either hydrolyzed or washed it off the foliage. Most residual activity of Orthene was gone after 7 days under the field conditions studied.

KEYWORDS: Pesticide residues, bioassay, insecticides (-forest pests, Orthene, Sevin-4-oil, Dylox, Douglas-fir tussock moth, *Orgyia pseudotsugata*.

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INTRODUCTION

The Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough) is an important defoliator of Douglas-fir, *Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco, and grand fir, *Abies grandis* (Dougl.) Lindl., in Western North America. During periodic outbreaks, extensive top killing, loss of growth, or outright killing of trees may result (Wickman 1963, Wickman et al. 1973).

In 1975, the U.S. Forest Service established a series of field tests to evaluate three chemical insecticides,[3] Sevin®-4-oil, Dylox®-1.5 and Orthene® 75S applied aerially with two spray systems producing different droplet sizes.[4] Susceptibility of different larval instars to one of the pesticides, Orthene (acephate), was also studied.[5]

The residual activity of the three materials under actual field conditions of a western coniferous forest is unknown, yet such information is necessary for choosing optimum timing of treatment by an insecticide. Should an insecticide be applied after hatch has occurred, sacrificing the new foliage consumed before treatment? Or should it be applied before hatch, letting the residual activity of the material kill the insects as they emerge, maximizing foliage protection?

As part of the 1975 Douglas-fir tussock moth program, a series of tests was set up to answer these questions.

MATERIALS AND METHODS

The study plots were on the Wenatchee National Forest on the east side of the Cascade Range about 20 miles (33 km) northwest of Ellensburg, Washington. Laboratory facilities were at the Department of Biology, Central Washington State College at Ellensburg.

Twelve plots, each 16 acres (6.5 hectare) and separated from each other by a minimum of 0.5 mile (0.8 km), were selected for the test. The three treatments and untreated control were replicated three times in a random block design with all replicates of a particular treatment at about the same elevation. In the center 2 acres (0.8 hectare) of each plot, 15 open-grown trees, both Douglas-fir and grand fir 30 to 60 ft high (9 to 18 m), were selected as sample trees. Application was made when 90 percent of the bud caps had fallen from the new growth of Douglas-fir.

All applications were made with a Hiller 12 E helicopter using a 30-ft (9.14-m) boom equipped with Spraying Systems (Wheaton, Illinois) T8002 flat fan nozzle tips. Spraying started on the downwind side of the plot and progressed upwind with swaths spaced 50 ft (15 m) apart and the helicopter flying 35 to 50 ft (11-15 m) above the treetops.

Sevin®-4-oil was diluted 1:1 with diesel oil and applied at the rate of 2 lb AI/acre in 1 gal of formulation. Dylox®-1.5 containing 1.5 lbs AI/gal of carrier oil, was applied undiluted at the rate of 1 gal/acre. Orthene® 75S was applied at 1 lb AI/acre in 2 gal water. Each gallon (3.789 l) of spray solution contained 3.8 grams of Rhodamine B dye for spray deposit assessment. For Sevin and Dylox, the dye was first mixed in oleic acid (94.6 ml/gal) to make it more soluble in oil.

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[3] Mention of a proprietary product does not constitute an endorsement by the USDA. This paper reports the results of research work only. Mention of a pesticide does not constitute a recommendation for use by the USDA, nor does it imply registration unless specifically stated. All uses of pesticide must be registered by the appropriate State and Federal agencies before they can be recommended.

[4] Markin, G. P., R. Orchard, H. O. Batzer, and J. W. Brewer. 1975. Effectiveness of three insecticides applied at droplet sizes for control of the Douglas-fir tussock moth and western spruce budworm. Manuscript in preparation.

[5] Brewer, J. W., and G. P. Markin. 1977. Bioassay of acephate-treated foliage on three instars of the Douglas-fir tussock moth. [In press.]

Spray deposit was sampled with two aluminum plates and one white Kromekote card placed in an open area adjacent to each sample tree. The amount of deposit was determined by fluorescent methods (Yates and Akesson 1963) and converted to gallons per acre. Droplet density and volume-median diameter[6] of deposit were determined with a Quantimet 720 (Imanco Image Analyzing Computer and Co., Monsey, N.Y.), which electronically measured and counted droplets larger than 20 micrometers.

Samples were collected 24 hr before treatment and at 30 min (Sevin and Dylox) or 24 hr (Orthene) and 3, 7, and 14 days after treatment. Samples were collected with an extendable pole pruner to remove three branch tips 14 to 16 inches (35.5 to 40 cm) long from the midcrown of each tree. Immediately after collection, the needles were removed from the basal 4 inches (10 cm) of the stems. The 3 branches from each tree were then placed in a perforated plastic bag and the sack sealed around the stems. The foliage was transported to the laboratory where within 5 hours after collecting, the base of the branches were placed in water (fig. 1). In each sack, ten 3d-instar, laboratory-reared Douglas-fir tussock moths were introduced through a slit in the sack, which was later closed. The insects were allowed to feed for 7 days, after which the sack was opened and the number of dead and live larvae counted to determine the percent mortality. Similar samples were collected from trees in untreated plots to serve as controls. Results were converted to percent mortality for each insecticide and analyzed for analysis of variance using a simple contrast between the various sampling intervals. All differences were judged for significance at the 0.05 level.

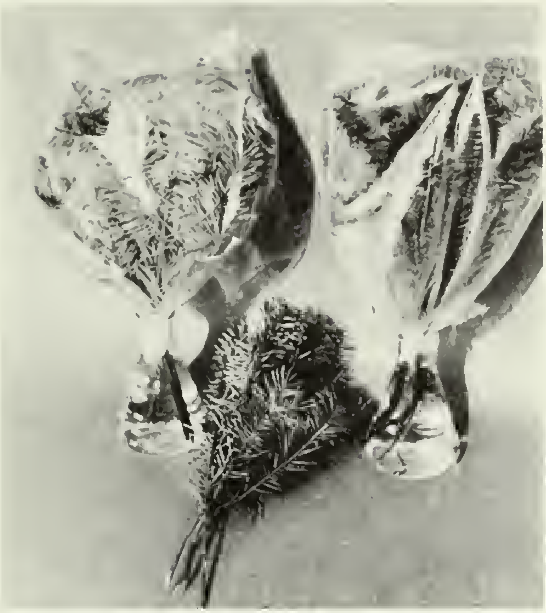

Figure 1.--Foliage placed in plastic bags and used to bioassay Douglas-fir tussock moth larvae.

Applications were made on June 16 (Orthene) and June 18 (Sevin and Dylox). Two short, intense rain showers occurred late in the afternoon of June 18, 0.3 in (0.8 cm), and June 19, 0.2 in (0.5 cm). Thus, rain fell on the Orthene plots 2 days after treatment and on the Sevin and Dylox plots 7-10 hours after application and again after 31 to 34 hours. No detectable rainfall occurred during the remaining 2 weeks of the study.

RESULTS AND DISCUSSION

Results of spray deposit analysis are shown in table 1. Variation in the amount of material recovered is considered normal, because several outside factors (such as wind, temperature, and canopy density) can significantly affect the amount of material reaching the ground surface. At best, spray recovery

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[6] Volume median diameter is the droplet diameter satisfying the requirement that half of the volume of liquid is in droplets smaller and half is in droplets larger than the vmd.

Table 1--*Spray deposit from aerial application to field plots, 1975*

Treatment	Replicate	Application: Active ingredient	Application: Spray volume	Atomization	Recovered deposit	
		Lb/acre	Gal/acre	μm	Droplet/cm^2	Gal/acre
Sevin-4-oil	A	2	1	316	11.9	0.051
	B	2	1	336	17.2	.118
	C	2	1	253	16.9	.113
Average				302	15.3	.094
Dylox-1.5	A	1.5	1	331	1.7	.044
	B	1.5	1	331	7.0	.383
	C	1.5	1	352	6.1	.230
Average				338	4.9	.219
Orthene 75S	A	1	2	253	29.1	.764
	B	1	2	243	12.9	.579
	C	1	2	256	11.7	.590
Average				251	17.9	.644

at ground level can only be used as an approximation of the amount and droplet size of the deposit reaching the forest canopy.

The plastic sack allowed the foliage to remain fresh and attractive to the insects for the 7 days. The development of the insects on the foliage from pretreatment collection and check plots appeared to be similar to insects being reared on artificial diets.

The mortality (table 2) is based on the percentage of dead insects found in the same sack after 7 days

Table 2--*Douglas-fir tussock moth mortality in laboratory bioassay of treated foliage using 3d-instar larvae, mortality determined after 10 days of exposure*

Treatment	Replicate	Percent mortality from foliage collected at: Pretreat		30 min		1 day		3 days		7 days		14 days	
		Mean[1]	SE[2]	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Sevin-4-oil	A	2.0	1.3	92.0	5.0			78.5	5.8	89.2	5.0	82.0	7.7
	B	2.0	1.3	70.7	5.9			72.0	7.6	88.0	6.7	84.7	5.3
	C	7.0	3.1	97.9	2.0			87.2	3.7	86.0	5.6	94.7	3.3
Average		3.7a	1.7	86.9b	8.3			79.2b	4.4	87.7b	.9	87.1b	3.9
Dylox-1.5	A	1.0	1.0	51.7	7.6			4.7	1.6	16.7	3.9	5.3	5.3
	B	2.0	1.3	65.3	7.5			12.0	2.4	12.0	3.0	4.7	1.9
	C	2.0	1.3	82.7	7.2			8.7	3.6	6.0	3.7	11.3	6.6
Average		1.7a	.3	66.6b	9.0			8.5a	2.1	11.6a	3.1	7.1a	2.1
Orthene 75S	A	1.0	.7			88.0	6.6	31.3	9.4	14.1	3.8	8.0	3.4
	B	0.0	0.0			60.0	12.2	47.3	11.7	7.3	2.1	19.3	4.7
	C	2.3	1.0			94.7	2.7	78.0	7.4	12.0	2.2	4.0	1.6
Average		1.1a	0.7			80.9b	10.6	52.3b	13.7	11.1a	2.0	10.4a	4.6
Control plots	A	0.0	0.0			4.0	1.3			6.0	2.2	4.0	1.6
	B	0.0	0.0			4.0	1.3			6.0	1.6	4.0	2.1
	C	2.0	1.3			1.0	1.0			5.0	2.2	4.0	1.3
Average		.7	.7			3.0	1.0			5.7	.33	4.0	0.0

[1] For a given insecticide averages followed by the same letter are not significantly different; $P \leq 0.05$.

[2] The standard errors shown for each replicate are within plot sampling error based on 15 trees. The standard errors for the averages are based on the average of the 3 replicates.

of feeding, averaged for the 15 samples per plot. The field life of Sevin for the 2 weeks of the study was excellent. The residual activity of Dylox was very low; 3 days after treatment all activity had been lost. Some of the loss of activity is attributed to rain showers that occurred on the day that the Dylox 1.5 was sprayed. At a temperature of 20°C, Dylox is 9-percent soluble in water and is also readily hydrolyzed.[7]

Information provided by the manufacturer of Orthene suggested that Orthene has some systemic activity and that, within a few hours after treatment, some material should be absorbed into the treated foliage providing some residual activity. The bioassay, however, indicated that under our test conditions little residual activity remained after 7 days.

CONCLUSIONS

The relatively long residual activity of Sevin suggests that it might be applied early in the larval stage of the tussock moth to ensure maximum foliage protection. Treatment programs could begin at or before larval hatch because sufficient quantities would remain active until hatch was completed. Because of the short field life of Dylox and its rapid deactivation by water, we suggest that application of this material be delayed until hatch of the tussock moth is complete and the larvae are on the new foliage and fully exposed. Also, application should be made when no heavy dew is on the foliage and no rain predicted for 24 hr.

Orthene had a very short field life. For this reason its application should be delayed until the new larvae are exposed and feeding on the new foliage.

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[7] Technial Information Sheet, "Dylox Insecticides" by Chemagro Agricultural Division, Mobay Chemical Corporation, Kansas City, Missouri. March 1973.

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